II. *A Letter from Mr.* John Winthrop, Holliſian *Profeſſor of* Mathematics *and* Aſtronomy *at* Cambridge *in* New-England, *to* C. Mortimer, *M. D. Sec.* R. S. *concerning the* Tranſit *of* Mercury *over the* Sun, April 21. 1740. *and of an* Eclipſe *of the* Moon, Dec. 21. 1740.

SIR,

Read Nov. 3. 1743. THOUGH I have not the Honour to be known to you, I flatter myſelf you will excuſe the Freedom of this Letter, ſince the Deſign of it is to lay before you an Obſervation which, I hope, may be of ſome Uſe in Aſtronomy. In Confidence of this, I take the Liberty to inform you, that, on the 21ſt of *April* 1740. I had an Opportunity to obſerve *Mercury*, then near his deſcending Node, tranſiting the Sun's Disk. Being advertiſed by the Calculations of that excellent Aſtronomer Dr. *Halley*, that the former Part of this Tranſit would be viſible in our Horizon, I was reſolved to obſerve it in the beſt manner I could, with thoſe few Inſtruments I was furniſhed with; which were only thoſe I had received from my Predeceſſor Mr. *Iſaac Greenwood*, and are the ſame that are mentioned by the late Mr. *Thomas Robie* in *Philoſophical Tranſactions* N° 382. being a 24 Foot Teleſcope, another of Eight Foot, and a braſs Quadrant of Two Foot *Radius*, fitted with teleſcopic Sights, and having croſs Hairs fixed in the *Focus* of the Glaſſes. All theſe I got in Readi-

Readineſs, being the more deſirous to make this Obſervation, becauſe *Mercury* had never as yet been ſeen entering upon or going off the Sun's Limb at his deſcending Node, and this *Tranſit* ought to be inviſible to *Europe*. The better to obſerve *Mercury*'s Ingreſs on the Sun, I determined to make uſe of my 24 Foot Tube, while an Aſſiſtant I had with me uſed that of Eight Foot: After which I propoſed, in order to find out *his* Path in the Sun, to obſerve the Paſſages of *Mercury* and the Sun's Limbs by an horizontal and vertical Hair in the Teleſcope of the Quadrant; and I choſe rather to deduce *Mercury*'s Right Aſcenſions and Declinations by Calculation from hence, than to obſerve them immediately in the common way of placing one of the croſs Hairs parallel to the Equator, *&c.* becauſe, as the Sun was likely to be low before *Mercury* made his Entrance, Refraction would have cauſed conſiderable Errors in the Places of *Mercury* determined in this Manner. Having no Clock, I was obliged to make uſe of my Pocket-Watch, which I know to be a good one; and by this it was eaſy to diſtinguiſh Time to a Quarter of a Minute, which would have ſerved pretty well for the Ingreſs of the Planet. But as it was by no means ſufficient for thoſe other Obſervations I deſigned to make, I procured another Watch, which ſhewed Seconds; and both theſe Watches I adjuſted to the apparent Time, by ſeveral Altitudes of the Sun taken with the Quadrant before the *Tranſit* began; and by Altitudes taken the next Day, I found that the Watches had kept time exactly enough. I expected that the Centre of the Planet would enter upon the Sun at $5^h\ 2'$; but, being apprehenſive that he might

be earlier than the Calculation, I, for ſome time before that, with my 24 Foot Tube directed to the Sun, kept my Eye fixed on that Part of his Limb where the Planet was to enter, as ſteadily as I could for the Wind, which then blew freſh. This Precaution was not needleſs; for, at 4^h, $54'$, $59''$, I perceived that *Mercury* had made an Impreſſion on the Sun's Limb; by the Quantity of which I concluded, that almoſt One quarter of his Diameter might be entered. After I had beheld this very plainly about a Minute, a ſmall Cloud covered the Sun near $3'$; which then clearing off, and the Sun ſhining very bright, as before, I had again a diſtinct View of the Planet, and ſaw much more than half his Body on the Sun. I continued to ſee him till 5^h $0'$ $40''$, at which time he ſeemed to be gotten almoſt wholly within the Sun; for he appeared now very near round, though I could not yet diſcern the Sun's Light behind him. By the ſhaking of the Tube, I unfortunately miſſed the Moment of his interior Contact with the Sun's Limb, but am certain it could be but very little later than this; for I preſently after ſaw him fairly within the Sun. Upon which, I repaired to my Quadrant; but this being at my Lodgings, at ſome Diſtance from the long Teleſcope with which I obſerved the Ingreſs, and which I had no Convenience for raiſing nearer Home, almoſt half an Hour ſlipped away before it was poſſible for me to begin my Obſervations. I began them as ſoon as I could, and continued them till Sun-ſet, excepting when I was interrupted by the Clouds; and I obſerved ſometimes one and ſometimes the other Limb of the Sun, as I found it moſt convenient. It will be needleſs, I

ſup-

ſuppoſe, to give a Detail of all the Obſervations I made; I ſhall therefore ſelect Two or Three, which I look upon as moſt exact, and moſt ſuitable to my preſent Purpoſe. One was as follows:

	h.	′.	″.
The Sun at the Horizontal .	5.	37.	59.
The Sun at the Vertical . . .		39.	1.
Mercury at the Vertical . . .		39.	16.
Mercury at the Horizontal .		40.	1.

This Obſervation gave me the *Azimuth* and Altitude of *Mercury* at his Paſſage by the vertical Hair; from whence I computed his Right Aſcenſion and Declination, and from thence his Longitude and Latitude. The Method of obtaining which being ſufficiently known, I ſhall ſay nothing upon it, but only mention the Reſult of the Numbers, which was, that at $5^h, 39', 16''$, when *Mercury* paſſed the Vertical, his Longitude was $12°, 43', 5'', 8$; and the Sun being then in $12°, 42', 27''$ of that Sign, *Mercury* was, in conſequence of the Sun's Centre, $38''$, his Latitude at the ſame time being $15', 2''$ North. Another Obſervation was thus:

	h.	′.	″.
The Sun at the Horizontal .	6.	47.	37.
The Sun at the Vertical . .		48.	17.
Mercury at the Vertical . .		48.	25.
Mercury at the Horizontal .		49.	24.

From hence I concluded, that at $6^h, 48', 25''$, *Mercury* was in Antecedence of the Sun $3', 57''$, with $14', 20''$ North Latitude. I made another Obſervation after this; but the Sun being then very near the Horizon, his Limbs were not well defined, ſo that I look upon this Obſervation as much preferable to that. I

ſhall ſet down only Two more, which were made about the Middle between theſe Two; and were made by the Sun's upper Limb.

	h.	′.	″.
The Sun at the Vertical . .	6.	6.	56.
Mercury at the Vertical . .		7.	8.
Mercury at the Horizontal .		8.	42.
The Sun at the Horizontal .		9.	45.

	h.	′.	″.
The Sun at the Vertical . .	6.	17.	18.
Mercury at the Vertical . .		17.	29.
Mercury at the Horizontal .		18.	26.
The Sun at the Horizontal .		19.	32.

At the former of theſe Obſervations, *viz.* $6^h, 7', 8''$, I computed the Longitude of *Mercury* to be in $12°, 42' 17''$ ♉, which being taken from the Sun's Place in $12°, 43', 35''$ ♉, leaves $1', 18''$ for the Difference of Longitude between the Sun and *Mercury*; and his Latitude was then $14', 47''$. At the latter Obſervation, the Difference of Longitude was $1', 55''$, and the Latitude of *Mercury* $14', 42''$.

From theſe Places of *Mercury* it appears, that his horary Motion in Longitude from the Sun was now $3', 58''$; according to which, if we ſuppoſe the central Ingreſs to have been at $4^h, 57'$, we ſhall find the Difference of Longitude at that time $3', 20''$; and the Semidiameter of the Sun being $15', 57''$, the Latitude of *Mercury* muſt be $15', 36''$. Now the Angle of *Mercury*'s viſible Way with the Ecliptic being, by the Theory of his Motion, $10°, 23'$, we muſt conclude the former of the obſerved Latitudes about $4''$ too ſmall, and the latter as much too large;——an Error very inconſiderable in this kind of Obſervations.

tions. From theſe things we may gather by an obvious Computation, that *Mercury* was in Conjunction with the Sun, in reſpect of Longitude, at $5^h, 47'$, with $14', 59''$, North Latitude; and that his neareſt Diſtance to the Centre of the Sun was $14', 44''$; and when he was at his neareſt Diſtance, the Difference of his Longitude from the Sun's was $2', 39''$, which he paſſed over in $40'$ of Time, and conſequently arrived at the Middle of his Courſe in the Sun at $6^h, 27'$: Whence the Semiduration of the central *Tranſit* was $1^h, 30'$, and the End at $7^h, 57'$, an Hour after Sun-ſet.

As to the Place of *Mercury's* Nodes, the Inclination of his Orbit to the Ecliptic, and the other Elements of his Theory, I pretend not to determine any thing from ſo ſhort a Series of Obſervations as this. I content myſelf with the foregoing Determinations, which, I hope, are not far from the Truth, having taken all the Care I could, both in the Obſervations and Calculations.

I was in Hopes to have made a good Obſervation of the Lunar Eclipſe, which happened laſt Week: But the Sky, which at the Beginning of the Eclipſe was very clear, ſoon became overcaſt, which hindered me from making above One or Two Obſervations that I could depend upon; and they were as follows:

21 *December* 1740.

	h.	′.	
At	5.	24.	A plain Penumbra.
		35.	The true Shadow ſeems to enter.
		47.	Touches *Palus Maræotis*.
		53.	Reaches *Mount Sinai*.

After

After this the Clouds thickened, and covered the Moon till the End of the Eclipſe, which was about 8^h, 30′, as near as I could gueſs through the Clouds.

The Night before the Eclipſe, *viz.* 20 *December*, at 12^h, 14′, I ſaw the Moon eclipſe a Fixed Star, which, I think, is in the Heel of *Caſtor*.

Theſe Two laſt Obſervations were made with an Eight Foot Teleſcope, my Watch being rectified to the apparent Time by correſpondent Altitudes of the Sun, taken with the before-mentioned Quadrant for ſeveral Days together, before and after the Eclipſe.

I muſt ask your Pardon for this long Trouble, and am,

SIR,

Your moſt humble Servant,

John Winthrop.

Cambridge *in* New-England, Dec. 30. 1740.

III. *An Account of the* Tranſit *of* Mercury *over the* Sun, Oct. 25. 1743. *in the Morning, obſerved at Mr.* Geo. Graham's *Houſe in* Fleetſtreet.

Read Nov. 3. 1743.

THE Beginning could not be ſeen by reaſon of Clouds, but about 8^h, 45′, *Mercury* was ſeen (through a reflecting Teleſcope Three Foot *Focus*, magnifying about 50 times) about Four or Five of his Diameters within the Sun's Limb.

At Mr. *Short*'s Houſe in *Surrey-ſtreet*, *Mercury* was ſeen juſt paſt the interior Contact 8^h, 30′, 59″, through